GEOPOLITICAL E-ANALYSIS BASED ON E-LEARNING CONTENT

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ABSTRACT

In a world of great complexity, understanding the manner states act and react becomes more and more an intriguing quest due to the multiple relations of dependence and interdependence that characterize "the global puzzle". Within this context, an analysis based on a geopolitical approach becomes a very useful means used to determine not only the rank of some states from a region that is under observation, but also to identify the type of relation established between them according to the power potential they have. As an academic discipline, Geopolitics is meant not only to develop students' critical and creative thinking, but also to connect the most diverse fields of research and knowledge in order to get "the whole picture". Under this circumstance, given the need of simulation during the seminars, the paper proposes developing a geopolitical lesson, allowing students to analyze factors influencing the ranking of countries in terms of three criteria: economic, military and territorial. The geopolitical lesson, designed in Java, allows students to first establish the importance of a criterion in relation to the other and establish relative weights. Each criterion contains a variable number of sub-criteria that can be selected or disposed in the hierarchy made in order to determine the possible degree of influence of the region. To determine the weights associated with the three criteria, after selecting the importance for each criterion, Analytic Hierarchy Process algorithm was used and in order to establish the influence "ability" of the states in the region, Electre Method was implemented, which allowed a hierarchy of countries considered. Moreover, this paper demonstrates that a complex situation related with the international security environment can be analyzed in order to be understood and/or solved by using not only empirical case study, but also simulation.

KEYWORDS

Simulation based-learning, geopolitical lesson, java application

1. INTRODUCTION

Approaching the subject of analysis with the help of game-based learning, gamification or simulation-based eLearning is a new trend in providing knowledge. This suggests that information, knowledge is put in a context or scenario as real as possible to meet the student's needs in the learning process. Each of the learning methods can be applied to all levels of knowledge if they are adapted and designed according to the target groups. In game based learning and gamification, the core element is the game or game-specific mechanisms in order to encourage an appropriate learning behavior, competition or exceeding their own progress (Perrotta, C. et al., 2013). In simulation-based learning it is very important that visual instruments are in accordance with the designed pedagogical objectives and the student can test and check lab or seminar homework in agreement with the themes discussed. In terms of teaching, presentation accompanied by explanations and demonstrations may lead to achieving the designed objectives. Moreover, if phenomena described are accompanied by some practical-applied approach that is able to simulate the results by changing the input parameters, understanding and learning could be visibly improved. In a blended learning, and not only, simulation has beneficial effects both during face-to-face courses and online and can be successfully applied especially in seminar sessions if allowed. Although in terms of teacher, the effort to generate simulations may be higher. Lately it is considered that text-based learning is over and the focus is on simulation-based learning, especially in areas where the laboratories equipped to meet the latest requirements involves a considerable financial effort (Moreno-Ger P. et al., 2010). On the other hand, the simulation creates a certain level of interaction and is intended to transfer knowledge from a mentor to the student in a way different from the traditional course and at the same time a level of complexity in a controlled environment can be introduced (Deegan M. et al., 2014).

Given the need for simulation, no matter where it is applied, creating an eLearning object is aimed, which, from geopolitical perspective, allows students to become familiar with the factors that contribute to the analysis of the geopolitical framework and how these factors lead to a hierarchy of states' power in a given region. Initially, for testing the effects on groups of students, geopolitical lesson was designed in Java and used in the seminars for half of the students' groups, and then loaded on the institution's e-learning platform.

The rest of the paper is organized as follows: Section 2 provides the theoretical background related to the geopolitical context and methodology used and Section 3 focuses on the presentation of the Java-designed application and discussions on the observed impact among students.

2. APPROACHES USED IN CREATING THE LEARNING OBJECTIVE

The simulation-based Geopolitics lesson aims at understanding and analyzing the factors that contribute to national power, both in terms of national performances, and performance of other countries in a region. In literature, for measuring national power, various models were developed (Liao H. et al, 2015; Schwab K., 2016), but it was noted that national power is difficult to be measured (Chang C.L., 2004). In fact, power always depends on context and the context is given by the structure of the international system. This does not mean that evaluating the national power and understanding its projection at the international level are a lost cause.

In each of the models developed considered criteria's weights are equal, and for the determination of the country's power, world average energy consumption is taken into account. Because regional power hierarchy was wanted, we thought it would be more appropriate to assess countries economically, militarily and territorially based on national parameters, parameters dependent on the domestic policy of each country. Therefore, the model was carried out in the following steps:

- Criteria and sub-criteria that can influence regional hierarchy were determined;
- For each sub-criterion, values related to internal politics of each country of the ones considered were assigned;
- Criteria weights were determined, according to the degree of importance, and for the sub-criteria's weights within the criterion was considered equal;
- Based on the determined weights and the sub-criteria entering the model, the regional hierarchy was established.

2.1 Elements influencing Power of States

In the lesson designed, students can make a hierarchy based on three main pillars (criteria): economic and future development, military capability and territorial factors that contribute in different ways, depending on the weight associated with the hierarchy of states.

The economic dimension of the national security is very important not only due to the globalization process. Economy is the engine of a nation survival and the source of development for other fields of activity especially nowadays when the military power is no longer enough for a state to get a good ranking regarding its power of projecting the national interest abroad. From the economic point of view, the following criteria were chosen to contribute to the ranking of states:

- Gross Domestic Product per capita (GDP/C);
- Expenditure on research and development - a country where budget allocations for research and development are supported by the government can reach technological innovations beneficial for the economy and for the military development (Liao H. et al, 2015);
- Expenditure on education - a young educated person can be absorbed by the labor market and bring benefits in terms of economics. If absorption of the labor market due to low level of education is poor, not only will it lead to pressure on the state's social spending, but also to a large number of potential immigrants.

After the end of the Cold War, military has lost its supremacy in establishing "the global map of power and interest" which does not mean that it has not remain and important tool applied in foreign affairs. The military aspect of the national power can be quantified through factors related to:

- Military expenditure allocated from the state budget - this type of expenditure being directly related with the level of economic growth and development. But there are also exceptions, when the military budget is tailored rather according to the international ambition of a state than to its national output.

- The number of military personnel - a figure that in order to be relevant for a state's power must be analyzed together with other military or even economic criteria.

When talking about Geopolitics, territory becomes an indispensable element of the analysis. States get themselves into a competition that aims to control territory by using political, economic and military tools. Territorially speaking, elements that may influence the power of a state refer to:

- Land surface - it is generally considered that the size of a country is directly proportional to the reserves of natural resources. The higher the reserves are, the lower the dependency from other states is. There are also exceptions to this rule, very important being the geography itself and the strategic importance of the natural resources;

- Population - a sustainable economy cannot be sustained with labor shortages. In general, the higher the active population is, the cheaper the labor force becomes. And a cheap labor force can become a great attraction both for the national entrepreneur and the direct foreign investment;

- Sea outlet - the existence of the sea outlet may indicate a commercial and/or shipping and/or battle fleet, (access to) natural resources and tourist attraction. At worst it is seen as a challenge and at best, as an opportunity for fulfilling the national interest;

- Military alliances between states - meaning that the territories of such states are safely included under a common umbrella meant to provide security not only from military perspective, but also from an economic, political, cultural and societal point of view.

The research has taken into consideration 8 states belonging to the same geopolitical region. In the first stage, to every single state values for each sub-criterion within the three pillars (economic, military and territorial) were attributed.

Table 1. Values of sub-criteria associated for each country

	Economic and perspectives			*Military capabilities*		*Territorial*			
	GDP per capita	Government expenditure on education	Research and development expenditure	Military budget	Military personnel	Population (millions)	Sea/ ocean access	Allia nce	Area
Country1	7091.32	1775699158	398523407	660842590.3	47300	7114	1	1	108560
Country2	18325.89	8263944702	3851346741	1857935944	24800	10561	0	1	77210
Country3	11902.79	5420109863	1603790588	983346023.6	38500	9835	0	1	90530
Country4	1871.5	554610023.5	24605000.02	23940000.53	7750	3553	0	0	32870
Country5	12309.30	22479536133	4393089905	10234965210	172700	37967	0	0	306190
Country6	9438.99	5483511963	708753204.3	2592544556	151300	19760	1	1	230080
Country7	16648.06	3538309631	794314422.6	1001919327	15850	5422	0	0	48086
Country8	2051.64	5833546143	566786956.8	3479200134	204000	42501	1	0	579290

At first glance, the 8 countries cannot be ranked, on the one hand due to the high number of sub-criteria for which the hierarchy is desired, on the other hand, due to the varying weights associated with each criterion. Initially, in establishing the hierarchy, students can choose the degree of importance of a criterion in relation to the other considered, and within each criterion it will be considered that the weights for each sub-criterion are equal. In other words, countries' hierarchy or ordering according to the criteria considered is determined based on

$$Countries\ hierarchy: \max(w_1 \cdot E\,\&\,P), \max(w_2 \cdot M), \max(w_3 \cdot T) \quad (1)$$

where:

- *E&P – values associated with the sub-criteria from the economic and perspective pillar*;
- *M- military capability pillar*;
- *T – territorial pillar*;
- w_1, w_2, w_3 *– weights associated to the corresponding criterion, based on AHP algorithm.*

The three considered pillars contribute to varying degrees to the countries' hierarchy, based on the influence in the region and the weights associated to criteria will be stable with AHP algorithm. Thus, to determine weights associated with each criterion AHP algorithm (Analytic Hierarchy Process) was used, and then, Electre method was used as an outranking.

2.2 The Analytic Hierarchy Process

The AHP algorithm (Analytic Hierarchy Process) (Saaty Thomas L., 2008) allows determining the weights of each criterion according to the scale of importance of each criterion in relation to other criteria considered. The scale of importance was quantified by values between the range 1-9 and then the algorithm for calculating the weight was applied.

Table 2. Scale of pair wise comparison - The Saaty Rating Scale (Saaty Thomas L., 2008).

Intensity of importance (Saaty scale)	Definition
1	Equally importance
3	Somewhat more important
5	Much more important importance
7	Very much more important importance
9	Absolutely more important
2,4,6,8	Intermediate values

If we consider the criteria C_1, C_2, ... C_m, after selecting the importance of each criterion based on the scale, the associated weights can be determined.

Table 3. AHP algorithm for weight determination

	C_1	C_2	…	C_m		weight
C_1	a_{11}	a_{12}		a_{1m}		$w_1 = \frac{1}{m}\sum_i \frac{a_{1i}}{S_1}$
C_2	a_{21}	a_{22}		a_{2m}	=>	$w_2 = \frac{1}{m}\sum_i \frac{a_{2i}}{S_2}$
…	…	…	…	…		…
C_m	a_{m1}	a_{m2}		a_{mm}		$w_m = \frac{1}{m}\sum_i \frac{a_{mi}}{S_1}$
$\sum$	$S_1 = \sum_i a_{i1}$	$S_2 = \sum_i a_{i2}$	…	$S_m = \sum_i a_{im}$		$\sum_i w_i = 1$

Obtained vector $W = [w_1, w_2, ..., w_m]$ represents the importance of a criterion in relation with other criteria.

2.3 Electre Method

Electre method, based on concordance and discordance matrices, is a multi-criteria decision algorithm and allows the selection of the best option after a complete hierarchy of the variants considered. For a problem with *n* variants and *m* criteria, the steps in view of hierarchy are the following:

- Elements of the concordance coefficients' matrix are determined;

For each set of decision variants (V_k, V_l) concordance is calculated according to the formula (Figuera, J., Greco, S., Ehrgott, M., 2005):

$$c_{jk} = c(V_j, V_k) = \sum_{i \mid r_{ij} \geq r_{ik}}^{m} w_i,\ \mathrm{j}, \mathrm{k} = \overline{1, \mathrm{n}},\ \mathrm{j} \neq \mathrm{k} \tag{2}$$

In other words, the concordance index c_{jk} is determined as the sum of the weights corresponding to the criteria according to which V_j is better than variant V_k. Variance matrix $C \in M_{nxn}$ is quadratic and it expresses the superiority of variant „*k"* in relation to variant „*j"*

- discordance coefficients are calculated for each pair of variants

Discordance coefficients for each pair of variants are calculated:

$$d_{jk} = \begin{cases} d(V_j, V_k) = 0, if \quad r_{ij} \geq r_{ik} \quad \forall i = \overline{1, n} \\ \max\left\{ \dfrac{r_{ki} - r_{ji}}{\max\limits_{1<=l<=n}(r_{li}) - \min\limits_{1<=l<=n}(r_{li})} \right\} \ if\ r_{ij} < r_{ik} \end{cases} \tag{3}$$

where: $r_{ij,}$ are the normalized values of the variant "*i*" for criterion "*j"*.

Discordance matrix $D \in M_{nxn}$ is quadratic and it expresses the superiority of variant *"j"* in relation to variant *"k"*.

- outranking. For outranking, modified Electre method was used (Căruţaşu V., 2014). Therefore, initially, three matrices were determined *F*, *G* and *E*

$$F = \begin{cases} 1, \text{if } c_{kl} \geq \alpha \\ 0, \text{if } c_{kl} < \alpha \end{cases}, \quad G = \begin{cases} 1, \text{if } d_{kl} \leq \beta \\ 0, \text{if } d_{kl} > \beta \end{cases}, \tag{4}$$

where:

$$\alpha = \frac{1}{n(n-1)} \sum_{k=1}^{n} \sum_{\substack{l=1 \\ l \neq k}}^{n} c_{kl} \tag{5}$$

$$\beta = \frac{1}{n(n-1)} \sum_{k=1}^{n} \sum_{\substack{l=1 \\ l \neq k}}^{n} d_{kl}$$

and the matrix

$$E = (e_{kl})_{k \in \overline{1,m},\, l \in \overline{1,m}},\ e_{kl} = f_{kl} \cdot g_{kl} \tag{6}$$

In matrix E, the sum of elements is calculated in line, and alternatives are arranged in descending order of the obtained values. However, symmetrical elements can exist in matrix E, $e_{ij} = e_{ji} = 0$, where variants V_i and V_j cannot be compared. In order to avoid situations of impossibility of comparison, matrices $\tilde{D}$ and $\tilde{F}$ were determined as follows:

$$\tilde{D} = \left(\tilde{d}_{kl}\right)_{\substack{k=\overline{1,m} \\ l=1,m}},\ \tilde{d}_{kl} = c_{kl} - d_{kl} \tag{7}$$

where:

c_{kl},d_{kl} – are the elements of concordance and discordance matrices

$$\tilde{F} = \left(\tilde{f}_{kl}\right)_{k,l=\overline{1,m}},\ \tilde{f}_{kl} = \begin{cases} -, k = l \\ 1,\ \tilde{d}_{kl} > \tilde{d}_{lk} \\ 0,\ \tilde{d}_{kl} < \tilde{d}_{lk} \\ 1/2,\ \tilde{d}_{kl} = \tilde{d}_{lk} \end{cases} \tag{8}$$

Matrix $E+\widetilde{F}$ is calculated and the sums for each line are also calculated. To make the hierarchy, the sums obtained are also are ordered descending.

3. SIMULATION DEVELOPMENT

Geopolitical lesson, developed in Java, contains two classes for determining the weights of the criteria chosen using AHP algorithm (*public class extends AHP_formjavax.swing.JFrame*) and the countries' hierarchy based on the criteria's weights and values entered for each sub-criterion considered (*public class Hierchy extends javax.swing.JFrame)*.

Determination of weights is done after the student has assessed the relative importance of a criterion compared to other criteria considered. Thus, based on the values selected from the sites the combo boxes, a two-dimensional matrix is defined, whose elements can take values between the range 1-9 and reverse subunitary values. For example, if the economic criterion is more important than the military criterion in a moderate extent, option that is assigned a value of 4, then A(1,2) = 4 and A (2,1) = 1/4 (where A is a double type elements matrix of 3x3 size). After the construction of the matrix A, weights for each criterion are determined with AHP algorithm, weights which will be used in carrying out the countries' hierarchy. A variable number of sub-criteria were considered for each criterion, all sub-criteria have equal shares in the criteria they belong to:

$$\sum_{i=1}^{3} w_i^{\,e} + \sum_{i=1}^{2} w_i^{m} + \sum_{i=1}^{4} w_i^{t} = 3 \cdot \frac{w^e}{3} + 2 \cdot \frac{w^m}{2} + 4 \cdot \frac{w^t}{4} = 1 \tag{9}$$

where:
w^e–weight of the economic criterion
w^m–weight of the military criterion
w^t–weight of the territorial criterion

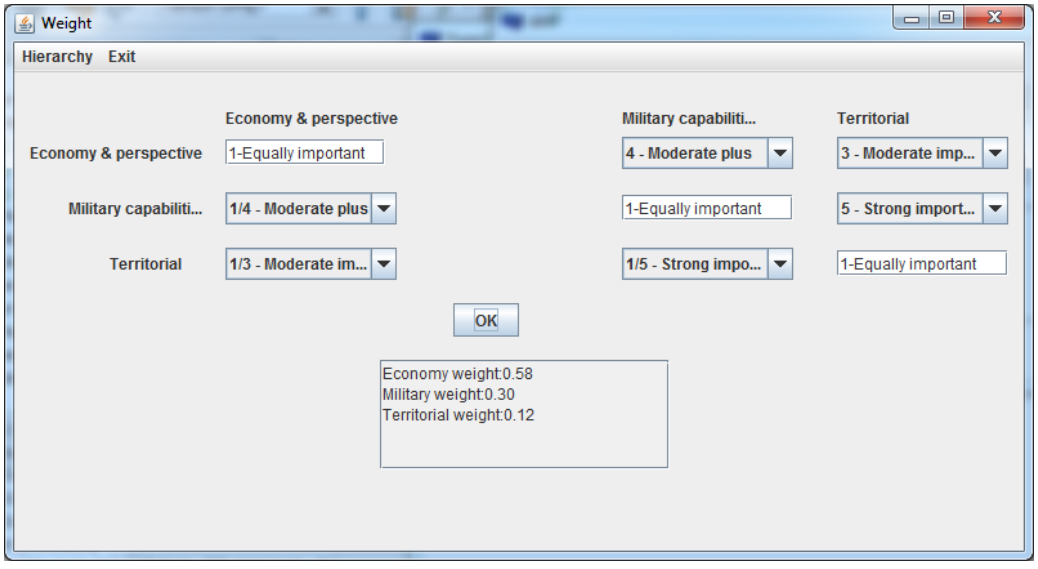

Figure 1. Significance of a criterion based on other criteria considered

On a first examination of the values entered for each sub-criterion (Figure 2), *Country5* reigns in terms of associated economic and military sub-criteria, but for the sub-criteria considered for the territorial criterion, *Country8* has the highest values for three out of four sub-criteria.

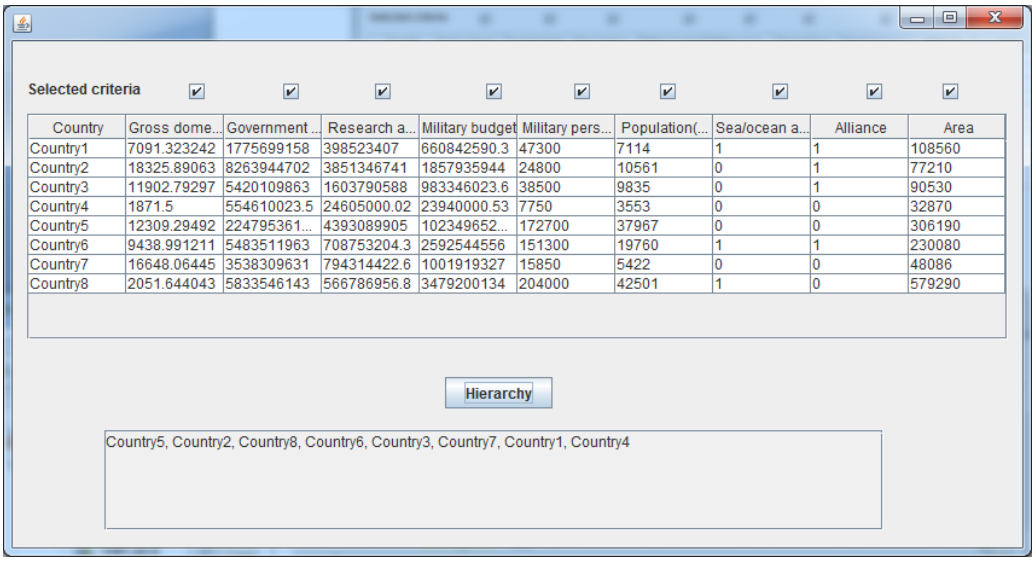

Figure 2. Countries' hierarchy

The obtained classification when weights 0.58, 0.30, 0.12 were considered for the economic, military or territorial criteria is illustrated in Figure 2, and is obtained from the implementation of the modified Electre method which allows the outranking of variants in the conditions under which each sub-criterion was associated the weight obtained with AHP, after selecting the button Hierarchy.

If territorial criteria are more important than economic and/or military criteria, hierarchy changes (Figure 3) and the first positions will be held by countries which, for the sub-criteria corresponding to the territorial criterion are larger.

Figure 3. Hierarchy obtained if the weight of the territorial criterion is greater

3.1 Analysis of the Impact

The impact of blended learning on students can be appreciated, in the short term, from their results in evaluations (Barsan, G., et al., 2009), and in the long terms, through student preferences towards the field of study. In both traditional and blending or online education, the level of knowledge acquired by each student is assessed on the basis of final course checks or intermediate checks. The advantage of using e-learning platforms is that learning or progression of learning can be evaluated by the tutor and, moreover, he can intervene with explanations or additional materials to correct the gaps without waiting for it to be too late for the student (Serrano A. et al., 2012). With the help of Lesson reports provided by LMS, which allows viewing the time spent by each student, test scores or questions that have raised difficulty, etc., the teacher can adopt other teaching strategies or, as the case may be, can discuss with the students who go out of the "box".

Students, who chose to study Geopolitics, from the third year of undergraduate bachelor studies, were divided into two groups. Each group consisting of 75 students - 5 girls and 70 boys aged between 21 and 26 is relatively homogeneous, meaning that the environmental, technological and contextual variables were the same (Attwell G., 2006). In addition, the interest of each student, regardless of the group to whom he was assigned, was the same - to get the highest score in the Geopolitics course. One group had access within seminar hours at the lesson designed in Java, and the others held classical seminar classes. At the end of the course, all students took an evaluation on eFront e-learning platform, and questions of various types -

multiple choices, fill in the blank, matching have been designed in accordance with the materials studied. The geopolitical lesson was associated with random questions such as: What are the factors influencing geopolitical analysis? Make a hierarchy of the factors that can influence the geopolitical context? Do you think that a large budget allocated to education could influence the hierarchy of regional powers? Explain your answer, so on.

The last question that all students had to answer was: How attractive was the Geopolitics lesson that determines a hierarchy of regional powers? At this question all students who had access to the platform replied that the lesson was attractive and that simulation helped them understand elements related to this issue, while only some of the students who had a classical seminar hour found the Geopolitics lesson interesting and to some extent attractive.

As the evaluation results, based on the reports on the eFront platform, it has been found that the first group understood better the theoretical notions and could operate with concepts studied, while the second group had problems of interpretation.

4. CONCLUSIONS

Designing a simulation tool that allows students to explore various scenarios is suitable for any field. Modifying options and viewing the results lead to a better understanding particularly of the lessons that require significant financial resources or for phenomena more difficult to explain. It was chosen that the Geopolitics lesson is loaded as .jar file on the platform and not applet, due to the browser limitations. An applet requires that on the client machine Java Runtime Environment (JRE) is installed and the browsers are not able to run the Java plug-in.

As a further development of the simulation-based lesson it is intended to add a higher level of generality to allow several students to add more options (Countries), criteria or sub-criteria. On the other hand, one wants to add elements of gamification to make the lesson more attractive and students more motivated and to create an e-learning object directly integrated into the lesson, allowing analyzes available within the platform, such as time spent in class or progress of each student.

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